THE APPLE BLIGHT.

The Bacteria Theory as Explained by Prof. Atkinson.

Raleigh News and Observer.

ITHACA, N. Y., June 17, 1886.

A few weeks before my departure from North Carolina my attention was called to a disease affecting the apple trees in the orchards of Prof. Mangum and Mr. Martin at Chapel Hill. President Battle also brought me some infested twigs and said that the disease appeared to affect the apple trees pretty generally throughout the State, and great anxiety was felt among fruit growers for its effect upon the apple crop.

The disease affects the young twigs of one or two years growth, causing the twig and leaves to die and the twig to blacken. The disease usually sets in at the terminal portion of the twig and advances toward the main branch. In many cases it reaches the portion of the twig on which the apples are borne and of course destroys the young fruit. My first care was to examine the twigs to be certain that the trouble was not caused by a minute insect, which often bores into the twigs at a bud or small branchlet and cutting off the supply of sap causes the death of the twig; or of larger insects, which with their sharp beaks sometimes pierce the tender and succulent branches and suck out their juices. A few traces were seen of both kinds of these insects, but on a careful examination of a goodly number of twigs it was plain that these were the chance attendants and not the cause of the disease, as by far the larger number of twigs bore no marks of insects. I then came to the conclusion that it was what is termed a "germ disease," caused by the presence of a microscopic plant belonging to the group of bacteria.

As the "bacterian theory" of the disease known for many years under the name of "pear blight," "apple blight," etc., was but recently propounded, and only within the last year confirmed by experiments that were not open to criticism, the results of some of which have not as yet been published, I wished to have access to the best and most recent authorities before attempting to give an account of this subtle and invisible foe. That the credulous may not think this a "yarn," spun to while away the tedious months of summer, I wish to state that the facts are based upon the investigations of some of our most accurate and scientific workers, and published in such works as the following: Proc. Am. Ass'n Adv. Sci. vol. XXIX, 1880, page 583; Rep. III. Ind. Univ. 1880, p. 62; Trans. III. Hort. Soc. 1880, p. 157; Am. Nat. Vol. XI., 1881, p. 527; Proc. Am. Ass'n. Adv. Sci. Vol. XXXIV., 1885, p. 295; Bot. Gaz. Vol. X., 1884, p. 343.

I also acknowledge the kind permission granted by Prof. Prentiss, of the botanical department of Cornell University, of consulting a recent unpublished manuscript deposited in the Cornell University library, by J. C. Arthur, of the New York agricultural experiment station, which embodies the results of the most recent and careful investigations upon this important subject.

DISTRIBUTION.

The disease is known to appear in the fruit trees of North America, east of the Rocky Mountains, and from Georgia and Mississippi on the South to Canada and Minnesota on the North. Thus far it is not known outside of this area.

HISTORY AND CAUSES.

It was mentioned as long ago as 1817 in the oldest pomological work published by an American author. In 1826 and 1832 considerable injury was done to pear trees. The great and widespread epidemic of the pear blight occurred in the year 1844. Though it has never been so prevalent and extensive in disastrous effects, it has appeared in one place or another at unequal periods and in varying power ever since, sometimes threatening to prevent the cultivation of fruit trees.

Several agencies have from time to time been advocated as the cause of the disease. In 1817 Coxe thought the rays of the sun acting through a moist or misty air deranged the physiological activities of the tree and produced the disease.

INSECT THEORY.

For a time it was believed to be produced by minute beetles which lived under the bark of the trees. The insect was supposed to poison poison the sap, and being so small was thought to be generally overlooked.

FROZEN SAP THEORY.

In 1884, H. W. Beecher, of Indiana, and A. J. Downing, of Downing's *Horticulturist*, supposed the disease to be caused by the freezing of the sap in the winter. A poisonous principle was thus induced, which was carried to all parts of the tree when the circulation became active in the spring. It was called the "Frozen Sap Theory" and was believed for a number of years to be the explanation of the disease.

FUNGUS THEORY.

This was set forth as a cause of the pear blight in 1863, and published in one of the Ohio agricultural reports. It found many supporters. Some thought it due to electrical disturbances, as it was often more noticeable after a thunder storm.

BACTERIAN THEORY.

We come now to the theory which is supported by the best investigations and experiments of the present day. Although bacteria had been noticed in connection with the disease prior to 1877, it was not supposed to be the cause. Prof. Burrill, of Illinois, noticed bacteria in connection with it, and in 1878 stated his belief that these organisms were the cause of the disease. He performed experiments in 1880 by inoculating healthy trees with the germs from diseased ones and succeeded in infecting those inoculated. In 1882 he named it "micrococcus amylovorus," which being interpreted means the minute starch-eating berry. To be certain that these germs caused the disease Dr. J. C. Arthur in 1885 separated the germs from the liquid in which they were cultured. Trees inoculated with the liquid show no signs of the disease, while those inoculated with the germs became infected. This demonstrated beyond a doubt the truth of the bacterian theory.

The micrococcus amylovorus bur is a one-celled organism generally believed by scientists to be a plant, but some eminent men believe the bacteria to be animals. They lie on the "border land" between plants and animals. That is, they possess the characters of both animals and plants in so marked a degree that it is difficult to say with certainty to which kingdom they belong. Politicians would say that they were "straddle the fence."

HOW THEY ENTER THE TISSUES OF THE TREES.

It has been found by numerous experiments that the germs will not enter through the bark except of very tender twigs and when but little moisture is present; but the main point of entrance is at the growing bud or opening flowers. Wounds produced by insects in the bark may afford an entrance. The germs cannot penetrate through the skin of the fruit, but when the fruit is affected by an insect or when from some other cause the skin becomes punctured they can enter. It requires some time, from two to three or four weeks, after the germs enter the tissues for the disease to become apparent. The organisms consume the oxygen in the starch of the cells, thus breaking down the tissues and causing death. When growing these minute organisms hop about with great alacrity, as can be seen with the aid of a powerful microscope. By this movement and through the circulation of the sap they are transported along the branch. They are oval in shape, and 4-100,000 to 6-100,000 of an inch long by 2-100,000 to 3-100,000 of an inch broad. Arranged in single file it would require about 25,000 to make a line one inch long, or 50,000 placed side by side to make a column of the same length; or again, it would require 1,250,000 of these little organisms to make a solid phalanx of an inch square!

The disease is of the nature of an epidemic. It may appear in a locality so as to do great harm with or without a preceding year of slight damage, and may be followed by one or two years during which it may be less virulent, followed by a longer or shorter period of absence.

Earlier than 1846 it was sometimes spoken of as "first cousin to cholera," "a species of vegetable ferment," etc. In the year 1846 it was believed by some to be of the nature of an epidemic, but not until 1878 were the bacteria believed to be the agency in causing and spreading the disease.

REMEDIES.

It is a cause for regret that for such an enemy to fruit trees as micrococcus amylovorus bur, after so much that is wonderful has been said about it by learned men, there is no efficient remedy for its destruction. All that at present can be done is to lessen the numbers and in this way check its multiplication. This should be done by watching the trees and cutting off all infested twigs and limbs about a foot below the infected part as soon as it is observed. All these should be immediately burned. This should be done as early as possible, for with the appearance of the disease there is a gum which exudes from the diseased tissues, bearing out with it numerous bacteria. The rains wash off this gum, it dissolves, the bacteria are set free and live upon any vegetable substance under the tree; endure the coldest winter and are ready the next spring to be carried in the air to the opening buds and flowers of the trees. Care should be exercised in cutting off the limbs not to let the knife cut the diseased part, for in cutting afterwards a healthy part this is liable to be inoculated with the bacteria clinging to the blade. It has been found by "cultures in solid mass" that the rapidity of the multiplication of the germ is in direct ratio to the water present. An economic suggestion comes from this, that moderate cultivation which will produce healthy trees and not very succulent stems is a factor in resisting the disease. Some varieties of fruits, especially of the pear, resist it more effectually than others. It affects apple trees differently from pear trees in this respect, that when a pear tree is attacked the disease advances into the large branches and eventually kills the whole tree, while only the twigs of the apple as a rule are affected.

There is a large field for investigation to discover an efficient remedy for this and similar diseases. Judging from the wonderful progress in the arts and industries resulting from the investigation of trained scientific workers we may confidently hope that some time in the future a remedy will be found for this enemy to the horticulturist, though as yet no indication of the remedy has appeared.

There is much that is useful to science and to horticulturists in having accurate observations of the effect and nature of such a disease taken by careful men. I wish to publish a few questions hoping that at least a few men in the State will note down their observations during the summer and send them to me at Chapel Hill, N. C., in September of this year. Careful attention to this by one owner of an orchard will be of service. It would still be better, however, if some would be responsible for counties, so that data for reference could be obtained from the whole State.

QUESTIONS.

1. When did the disease first make its appearance in 1886?
2. Did it appear on apple trees in immediately preceding years?
3. If so, how many years and what the extent of damage?
4. Varieties of trees most affected?
5. Condition of trees affected as regards succulency of twigs?
6. Length of diseased twigs (extremes and average)?
7. Number of years growth included in the diseased part?
8. Time of season when the disease seems to be at its height?
9. Time when progress of disease ceases?
10. Amount of damage done to trees (the average proportion of limbs of a tree killed)?
11. Amount of damage done to this year's apple crop?

This morning just as I had finished my letter a package of infested twigs arrived which were sent at my request by Prof. Love, Chapel Hill, N. C. I placed some very thin shavings from the inner bark on a glass slide and added a drop of water. The water immediately became clouded with a dull, milk-white color, from the presence of millions of the germs. Examining this with a microscope which magnifies 500 diameters, the one-celled germs could be distinctly seen, some quiet and collected in clusters, others independent and hopping and tumbling about in a very active manner. In some cases three or four cells were united. This happens from the manner of growth. A single cell, or plant, by assimilating nutriment elongates, and a partition forms, dividing it into two cells. It may grow so rapidly as to form three or four cells in a line with the partitions developed, but not quite mature enough to separate them into independent cells. Such a condition is called a colony. Each cell soon separates from the colony, becomes independent and capable under proper conditions of producing others. GEO. F. ATKINSON.

Farm Notes.

WHITE POTATOES PREFERRED.

In this season, when the rot in potatoes is so prevalent, the white varieties are least affected by disease. As some of these are good quality and good yielders, they will be largely planted hereafter.

FEEDING NEW OATS.

Excessive feeding of new oats will cause scours in horses, even if they do not induce more dangerous colics. Old horses especially should be fed only ground feed, as whole new oats pass through them doing little or no good.

ROTTEN POTATOES.

Some farmers are trying to console themselves with the idea that rotten potatoes left on the ground will be worth considerable as manure. The idea is fallacious. The potato is mainly carbon and has very little manurial value.

FALL-DRIED CORN.

In selecting seed corn the main point is to have it dried in the Fall before severe frosts have had a chance to injure it. The difficulty with much poor seed corn is that it is frozen first and the germ injured and then thoroughly dried afterwards.

TILLAGE DESTROYING WEEDS.

It is a general fact that cultivated fields are more free from weeds than those seeded down and left for either pasture or hay. The pasture lot is seldom ever mown as it should be, and as stock crop the clover and grasses weeds grow and seed without check.

IMPROVING THE FLAVOR OF MUTTON.

The flavor of mutton can be greatly improved by fattening upon the best of food and removing the viscera with all possible despatch after the animal is bled, using care not to cut or rupture the entrails, so as to bring their contents in contact with the carcass.

FAILURE TO FRUIT.

The failure of squashes and other vines to fruit is generally due to imperfect fertilization. It may be that pinching back will check the growth of vine and thus induce fruit production, but a more certain way is to artificially fertilize by transferring pollen to the female flowers.

MANAGEMENT OF TEAMS.

The trainers of successful trotters have justly claimed great credit for the performances of their charges. But it is just as true on the farm as on the road that what a team can do depends largely on their driver. A poor driver will worry out a team on a light load, while a good teamster will do the same work without injury.

PRUNING GRAPE VINES.

The best time to prune grape vines is as soon as possible after the leaves drop off in the Fall. Then the cut ends get dry during the Winter, and there is no danger of bleeding when the sap starts in the Spring. Trimming is very generally delayed until a leisure spell in Winter. There are many objections to this plan: If the work is done in very cold weather it is a slow job and takes double the time that would have been required if done in October or November. At the same time the canes are full of frost and are very brittle and liable to be injured by being broken off too short. If the work is done during a warm, thawy spell in Winter the ground is usually muddy or else covered with slush, and the job is a sloppy and disagreeable one.

RED CLOVER.

A successful Pennsylvania farmer believes red clover the most valuable of vegetables as a green manure or a mulch. Sowing late in the Spring on wheat lands, and harrowing it down with a common harrow, which will not hurt the wheat, in his judgment produces the best results. Clover growth is helped by lime and plaster. Large quantities of nitrogen are contained in the earth and air, and clover absorbs nitrogen more than any other plant. The plant and air work together in furnishing an exhaustless supply of food for all kinds of food plants. Wheat and other cereals cannot obtain enough nitrogen from the air to sustain them, but clover and other plants with dense foliage can do so, and when they are plowed down will furnish nitrogen and other plant food for the cereals.

OPEN-AIR ENSILAGE.

M. Houles, the French discoverer of the method of open air or stack silo, reports the continued success of his method. The secret of the success of this method lies in such uniform and continued pressure as will secure the expulsion of the air and thus prevent decomposition. The material is carted to the place of stacking as fast as cut without waiting for any drying, and is built up slowly and uniformly, allowing fermentation to start, making the forage more tender, care being taken to prevent the stack from leaning as it settles. When the stack is finished the top is covered with inch boards projecting a few inches over the sides, and then weighted at the rate of about 2,000 pounds to the square yard, with any convenient material, stones, earth or firewood. The only drawback to the plan is said to be the difficulty in keeping the sides perpendicular.

CARE OF FRUIT.

Care in gathering and barreling fruit for storing and keeping is of the utmost importance, and yet how often is fruit gathered when it would seem as if the chief end and desire was to promote decay as early as possible! They must be picked from the trees and handled carefully. Barrels are found to be convenient packages for apples, but they should be washed, cleaned and dried before using. Any nails on the inside should be removed. The fruit should be packed in the barrels as close as possible, and should be shaken down, to prevent any movement of the fruit after the barrel is headed. Each should be marked and placed where the temperature is as low and uniform as possible. If apples are to be stored for winter the sooner they are placed in a low degree of temperature the better. A fruit house is undoubtedly the best place, but most growers have to resort to their cellars.

MORE COMPETITION IN FARMING.

Farmers are generally of the opinion that their business is more largely overdone than any other. But as it is the pursuit which men go into when other avocations fail, then they are liable to have additional competition from most unexpected sources. The labor strikes have mostly failed, and with this failure employers are frequently discriminating against those most conspicuous in exciting discontent and strikes. On the Gould railroads in Missouri the management have refused work to all Knights of Labor. Many of these will be obliged to betake themselves to the farm, and mighty poor work they will make of it unless they are willing to labor on the farm under far severer rules than those from which they have revolted in the city. But all the same they will be nominally transferred to the list of agricultural producers rather than consumers, even though they grow little more than enough for their own consumption.

PROTECTION AGAINST THE BORER.

The borer is fatal to all peach trees not fully protected against its ravages. This can be successfully done by the application of the following wash:

Four gallons whitewash,
Two quarts clay,
Two quarts fresh cow droppings,
One quart lye that bears an egg.

Mix these ingredients to a proper consistency with water. Remove the ground from the top of the roots close to the tree, and apply the wash to the exposed roots and to the whole trunk of the tree, including the hollow between the lowest branches. Cover the roots again with earth. The wash can be applied very expeditiously by means of a corn broom; and no special pains need be taken against splashing any of the substance on the ground, for the women will raise no objection to such a mishap and the tree will eagerly appropriate the drippings, and put them where they will do the most good. The wash should be applied twice every season; namely, about the end of May and the end of August. I have found this an infallible protection of peach and apple trees against the borer. For apple trees one application of the wash every season is sufficient.—*From essay by Charles Shearer, read before Pennsylvania State Horticultural Society.*